

REMARKS

Reconsideration of the above-identified application is respectfully requested.

Claims 1–5 and 8–10 were rejected as unpatentable over Budd in view of Chandra et al. Claims 6 and 7 were rejected as unpatentable over Klinedinst et al. in view of Chandra et al.

It is respectfully submitted that there is no basis for the proposed combination other than applicant's claims; *In re Rouffet*, 47 USPQ2d 1453, at 1457 (Fed. Cir. 1998). The Examiner characterizes the processes claimed by applicant and disclosed by Chandra et al. as "chemical vapor deposition."

(1) The Examiner is not using the term in its ordinary and accepted meaning as known to those of skill in the art.

(2) The Examiner does not define the term "chemical vapor deposition."

(3) The Examiner is implying a broader meaning than exists in the art.

(4) The Examiner appears to be using a simplistic, semantic analysis that finds there are chemicals involved, there is vapor involved, and there is deposition involved, therefore it must be CVD. This is not a proper analysis of the claims or of the prior art.

(5) Enclosed are four selections from a brief search of the internet. Two relate to CVD and two relate to fluidized bed reactors. In the paper entitled "Chemical Vapor Deposition Reactors", note the absence of a fluidized bed reactor. In the paper from Kluwer Academic Publishers, containing the table of contents of a new book on CVD, note the absence of a fluidized bed reactor. In the two pages on fluidized bed reactors, note the absence of "chemical vapor deposition."

(6) The Examiner is combining unlike, unrelated technologies to make the rejection. The combination is technically in error and mystifying to the inventor.

(7) The mere mention of a gas, trichlorosilane, in the Chandra et al. patent does not imply or disclose every reaction in which that gas may be used.

(8) The Examiner's assertion that "Chandra et al. suggest using trichlorosilane for all CVD methods" has no basis in the patent or in reality.

used in the CVD processes include mixtures of silanes or halosilanes such as trichlorosilane in the presence of tetraethylorthosilicate, alkylsilanes such as trimethylsilane and silacyclobutane." The Examiner may not simply pick a chemical out of context.

(10) Trichlorosilane is not the same as organotrichlorosilane, as claimed.

The Examiner's attention is again directed to the following discussion of obviousness from *Mitsubishi Electric Corp. v. Ampex Corp.*, 51 USPQ2d 1910 (Fed. Cir. 1999).

"*Obviousness* The trial judge correctly instructed the jury that an obviousness determination requires consideration of the following:

One, what was the scope and contents of the prior art at the time the alleged invention was conceived; what were the differences if any between the prior art at the time the alleged invention was conceived; what were the differences if any between the prior art and the alleged invention, that is, what does this alleged invention add to what was already known; and three, what was the level of ordinary skill in the prior art at the time the alleged invention was made.

In making your determination you should also consider [secondary considerations] . . .

In order to be patentable, an invention must not be obvious to a hypothetical person of ordinary skill in the art at the time the invention was made . . .

See, e.g., *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966). With respect to how to analyze a combination of prior art references, the court instructed the jury as follows:


The mere existence in the prior art of individual features of a patented invention does not without more invalidate the patent under the obviousness test. There must be evidence that the bringing together of such features or steps would have been obvious to an ordinarily skilled person. It is improper to combine prior art references solely because the inventor's patent itself suggests the new combination of old elements. Thus, to combine any of the teachings of the prior art there must be some teaching or suggestion supporting the combination.

Further, you may not combine the features of prior products where the prior art itself teaches against the combination.

We discern no flaw in these instructions."

In view of the foregoing remarks, it is respectfully submitted that claims 1-10 are in condition for allowance and a Notice to that effect is respectfully requested.

Respectfully submitted,

A handwritten signature in black ink that reads "Paul F. Wille". The signature is written in a cursive style with a large, stylized 'P' and 'W'.

Paul F. Wille

Reg. No. 25,274

Attorney for Applicant

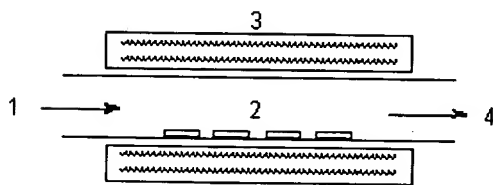
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Chemical Vapor Deposition Reactors

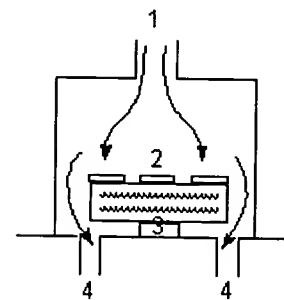
General System Requirements

- gas and vapor delivery lines
- reactor main chamber - hot wall, cold wall
- materials of construction / geometry
- substrate loading and unloading assembly
- energy source(s) - RF and radiant heating, plasma, photo irradiation
- vacuum systems - LPCVD
- exhaust system - byproducts removal
- process control and measurement gauges
 - gas flow rate, pressure, temperature, deposition time
- safety equipments!!!
 - hazardous vapor phase reactants and products are frequently encountered
 - ventilation, sensors, alarms are needed for protection

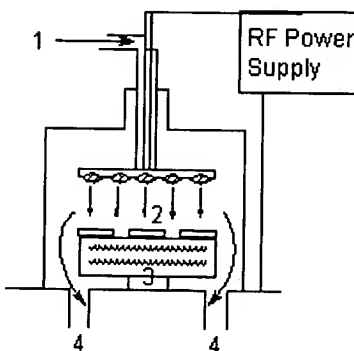
Examples of CVD Reactors



Horizontal Hot-Wall Reactor

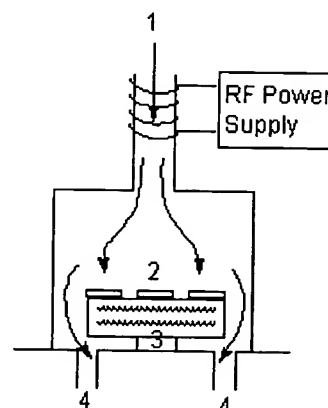


Vertical Cold-Wall Reactor



Parallel Plate Plasma Reactor

1: precursor in
2: substrates
3: heater or furnace
4: exhaust



Inductive Tube
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Commercial CVD system suppliers



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Principles of Chemical Vapor Deposition

What's Going on Inside the Reactor?

by

Daniel M. Dobkin*WJ Communications Inc., San Jose, CA, USA***Michael K. Zuraw***Fused Metals Inc., Georgetown, ON, Canada*

Acknowledgements. Preface.

- 1: Introduction. 1. What's behind the facade? 2. Generic reactors and process considerations. 3. Tube and showerhead reactor examples.
- 2: Reactors without transport. 1. What goes in must go somewhere: Measuring gases. 2. Review: Kinetic theory. 3. The zero-dimensional reactor. 4. Zero-dimensional tube and showerhead examples.
- 3: Mass transport. 1. Introduction to transport. 2. Convection and diffusion. 3. Diffusion: Physics and math. 4. Fluid flow and convective transport. 5. When flows matter: The Knudsen number. 6. Tube and showerhead examples. 7. On to photons.
- 4: Heat transport. 1. What is heat (energy) transport? 2. Heat conduction and diffusion. 3. Convective heat transfer made (very) simple. 4. Natural convection. 5. Radiative heat transfer. 6. Temperature measurement. 7. Tube and showerhead examples.
- 5: Chemistry for CVD. 1. What does the C stand for anyway? 2. Volatility, the V in CVD. 3. Equilibrium: Where things are going. Kinetics: The slowest step wins. 5. Real precursors for real films. 6. Tube reactor example. 7. A few final remarks.
- 6: Gas discharge plasmas for CVD. 1. Plasma discharges: An instant review. 2. The low-pressure cold-plasma state. 3. Key parameters for capacitive plasma state. 4. Alternative excitation methods. 5. Plasmas for deposition. 6. Plasma damage. 7. Technic details. 8. Ongoing example: Parallel plate reactor. 9. A remark on computational tools.
- 7: CVD films. 1. Why CVD? 2. Silicon dioxide. 3. Silicon nitride. 4. Tantalum pentoxide. 5. Metal deposition by CVD. 6. Concluding remarks.
- 8: CVD reactors. 1. CVD reactor configurations. 2. Tube reactors. 3. Showerhead reactors. 4. High density plasma reactors. 5. Injector-based atmospheric pressure reactors. 6. Reactor conclusions. Index.

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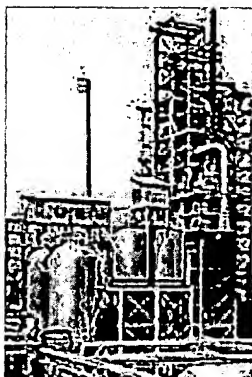
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The Fluid Bed Reactor



**PCLA #1 (Powdered
Catalyst Louisiana),
1942**

[From Kerosene Lamps to Airplanes](#)
[Searching for a Solution](#)
[Contemporary Fluidized Bed Applications](#)
[The People Involved](#)
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The first commercial circulating fluid bed reactor, PCLA #1 (Powdered Catalyst Louisiana), went on stream on May 25, 1942, in the Baton Rouge Refinery of the Standard Oil Company of New Jersey (now Exxon Corporation). This first use of powdered catalysts in continuous operation allowed the efficient cracking of heavy gas oils to meet the growing demand for high-octane fuels. PCLA #1 was dismantled in 1963 after 21 years of successful operation. Today, more than 350 fluid bed reactors, including PCLA #2 and PCLA #3, are in use worldwide for the manufacture of fuels, chemical intermediates, and plastics.

From Kerosene Lamps to Airplanes

The modern fuels manufacturing industry began in the mid-19th century with the separation of naturally occurring petroleum into three main fractions, naphtha, kerosene, and heavy oil, according to their boiling ranges. From the 1860s up to 1910, demand was primarily for kerosene for lamps. To make the lamps burn smoothly, it was important to separate all the low boiling naphtha fraction from the kerosene. Naphtha in the kerosene made the lamp sputter, or, at worst, explode. Early fuels manufacturing technology was simply a physical separation by distillation, with no chemical changes in the petroleum fractions. The first chemical reactions were introduced to control odor and color. For example, sulfur compounds, which have very strong odors, were removed by reaction with strongly basic compounds.

This chemical processing took place only on a very small portion of the product streams that went through the refineries.

Change in Demand

From 1910 to 1930 technological developments in other industries changed demands for various fuel products. Use of electric lighting caused slower growth in the market for kerosene, and the change in shipping from sail to steam and diesel engines (in ships and trains), plus the need for fuel to generate electricity, developed a market for the heavier, higher boiling fuel oils. However, the change that had the greatest impact on the fuels industry was the development of the gasoline engine and its application in both automobiles and airplanes. The demand for gasoline, which was made from the naphtha fraction, was much greater than the markets for other higher boiling liquid petroleum fractions.

Producing More and Better Gasoline

Engine builders had found that gasolines varied in their performance depending on the type of crude oil used for distillation. Better gasolines allowed engines to run with more power at a higher speed without damaging the engine. The poorer gasolines, in comparison, caused an engine to make a "pinging" or "knocking" noise and to run less smoothly. The "antiknock" quality of gasoline was expressed as an "octane" number on a numerical scale of pure chemical compounds as proposed in 1926 by Graham Edgar of the Ethyl Corporation. We now know that higher octane gasoline burns in a way that pushes the piston down smoothly during the power stroke. The lower octane gasoline burns too rapidly, and the sudden pressure rise makes the knock or ping in the engine cylinder, which can harm the engine.

In 1919, Charles F. Kettering and Thomas Midgley, Jr., of General Motors' Dayton Engineering Laboratories Company, had begun work on controlling engine knock. In 1921 they reported that a mixture of tetraethyl lead and gasoline eliminated knocking and performed like a higher-octane gasoline. Upon development of efficient tetraethyl lead (TEL) synthesis methods a few years later, refiners could provide a constant octane gasoline product from a variety of naphthas. In the late 1960s, as gasoline consumption grew, careful analytical chemistry showed that the lead additives contributed to the spread of the heavy metal into the roadside environment. The Environmental Protection Agency of the U. S. government and the fuel manufacturers agreed to phase out the use of the lead additives. The technology used today to produce plentiful, high octane, unleaded gasoline started with technical innovations introduced in the 1920s and 30s.

Prior to 1925, the higher boiling heavy-oil molecules were chemically changed to smaller naphtha molecules by heating to decompose them using a process called thermal cracking. Between 1925 and 1935, Eugene Jules Houdry and his co-workers demonstrated that a catalytic cracking process provided a greater yield of gasoline. In addition, the cracked naphthas were higher in octane than only-distilled naphtha. The first full-scale commercial fixed-bed catalytic cracking unit began production in 1937. It changed the industry.

Installation of Conversion Reactors

The change to production of fuels by chemical conversion rather than distillation required that the refineries install expensive, large capacity chemical reactors. In addition, the Houdry Process Co.

National Historic Chemical Landmarks

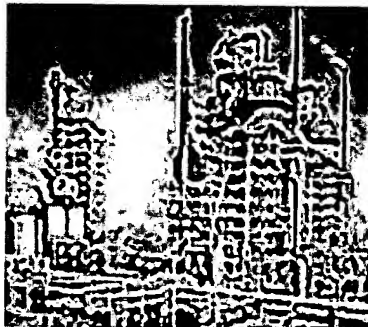
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The Fluid Bed Reactor

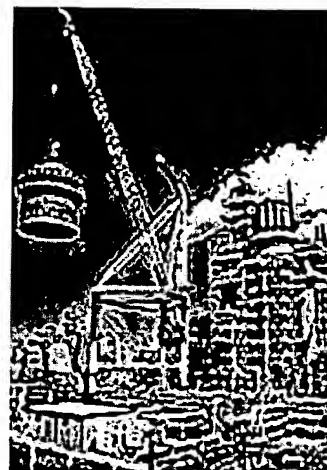
Contemporary Fluidized Bed Applications



PCLA #1, and #3, 1946. PCLA #1 was a large unit by 1942 standards. It was 19 stories tall and built with 6,000 tons of steel, 3,500 cubic yards of concrete, 85 miles of pipe, and 63 electric motors. It had a catalyst inventory of about 100 tons and could process 588,000 gallons of fuel per day.

After the war, demand for gasoline to fuel automobiles continued to increase. Today, more than 370 fluidized FCC units are in operation around the world. The FCC capacity in the U.S. increased from 50 million gallons per day in 1950 to over 210 million gallons per day in 1992. Over the same time period, world capacity is over 460 million gallons per day, up from 63 million gallons per day. As the demands for gasoline volume and qualities have changed, the incorporation of new catalyst technology in these versatile fluidized catalyst units has enabled fuels manufacturers to provide cleaner burning gasolines.

Today many chemical reactors use fluidized beds. For example, the commercial synthesis of acrylonitrile, phthalic anhydride, aniline, maleic anhydride, and a portion of the polymerization of ethylene (to polyethylene) and propylene (to polypropylene) are all done in fluid bed reactors. There are noncatalytic processes, such as ore roasting, coking, combustion of coal and other solid fuels, as well as purely physical processes such as drying and conveying of fine particle products like flour, rice, and cement, which use the principles developed for the fine-particle fluidized bed.



PCLA #1 was dismantled in 1963. The spot where it stood is to the left of the crane in this 1995 photograph made during the replacement of PCLA #3's regenerator.

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